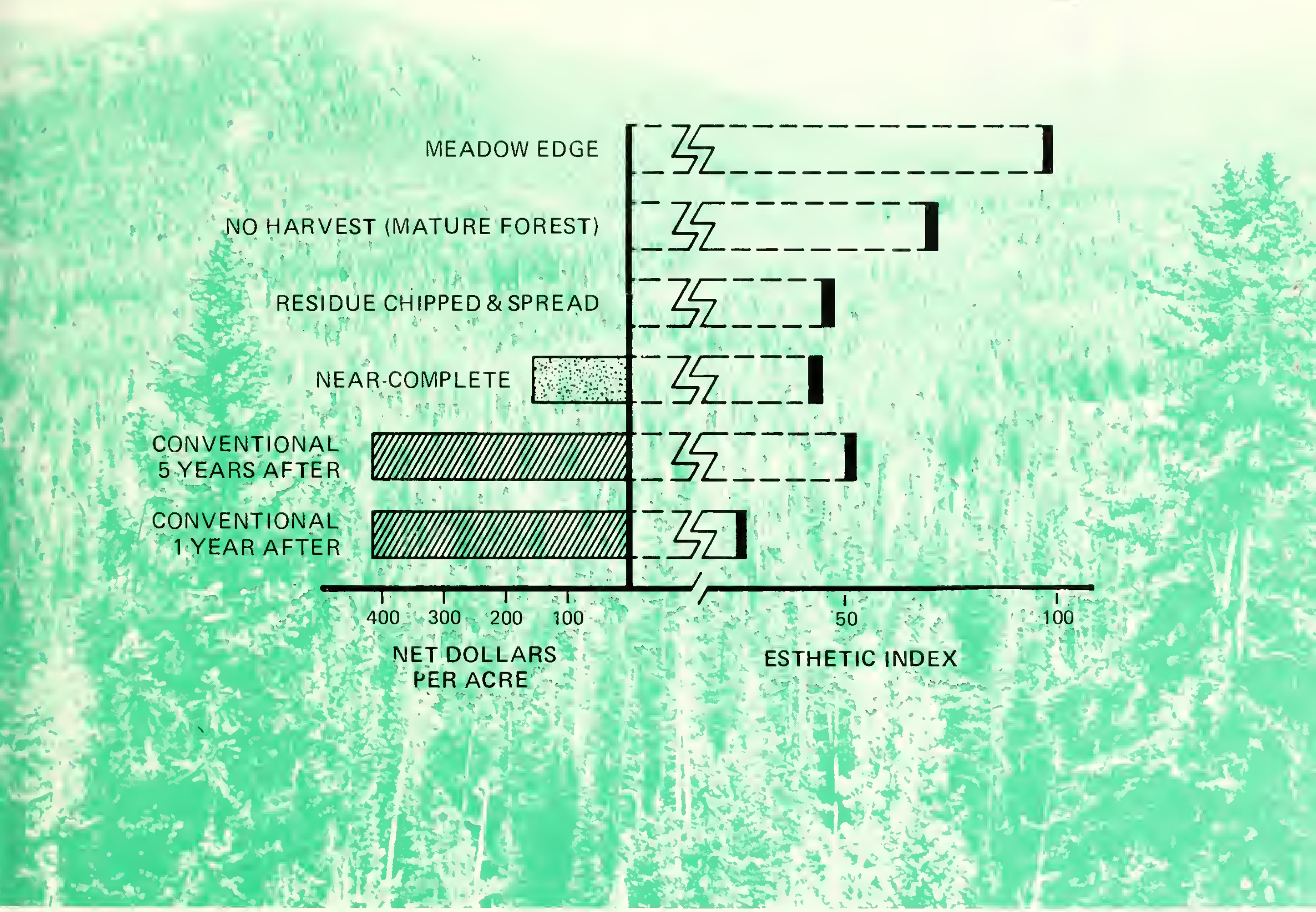
# LODGEPOLE PINE LOGGING RESIDUES: MANAGEMENT ALTERNATIVES

Robert E. Benson




USDA Forest Service Research Paper INT-160, 1974
INTERMOUNTAIN FOREST & RANGE
EXPERIMENT STATION
Ogden, Utah 84401

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

INT Missoula FSL

**REPLY TO:** 4710 Utilization Programs

March 12, 1975

**SUBJECT:** Wyoming Residue Study

**TO:** Participants, Wyoming Residue Study



This memo is to update what's been happening on our study. We're now into our fourth year and the bulk of the current work is evaluating the silviculture, hydrology, soil, and nutrient conditions. These studies are more or less tied together under the regeneration subcommittee.

The regeneration subcommittee met on January 23 at the Logan Laboratory and discussed status of their work. Norbert DeByle summarized the meeting in his memo of February 12 (INT-Logan, Utah 4720, to study participants).

Jim Lotan has transferred and DeByle has agreed to take over as chairman of the regeneration subcommittee. Wyman Schmidt is taking over Lotan's silviculture work, and will continue the studies on the planted stock, seed spots, and natural regeneration on the area.

A copy of the so-called benefit-cost summary is attached--this pulls together the work that has been completed thus far. I am hoping we can put together a similar more comprehensive report when all phases of the study are complete in 2 to 3 years.

I will continue to be study coordinator, but from a practical point of view, Norb and his committee will probably have more up-to-date answers on what is happening on the site than I will. If you anticipate any activities on the study that are to be funded by the Residue R&D Program, please continue to inform either me or Ron Barger.

As some of you already know, the Residues R&D is going to put out annual progress reports. Since our Wyoming study is included in this, the report will provide an annual synopsis of progress on the study. The first report will be ready in a few weeks.

Finally, thanks to all of you for your efforts in the study so far.

Bob Benson

ROBERT E. BENSON
Research Forester and
Study Coordinator

USDA Forest Service
Research Paper INT-160
November 1974

# LODGEPOLE PINE LOGGING RESIDUES: MANAGEMENT ALTERNATIVES

**Robert E. Benson**

A Cooperative Research Study Among:
U.S. Plywood - Champion International, Inc.;
and Intermountain Region, Teton National Forest,
Intermountain Forest & Range Exp. Station,
and Forest Products Laboratory, USDA
Forest Service

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Forest Service
U.S. Department of Agriculture
Ogden, Utah 84401
Roger R. Bay, Director

# THE AUTHOR

ROBERT E. BENSON is a research forester assigned to the Forest Residues Utilization Program, and has been with the Intermountain Station in Ogden and Missoula. His research work includes studies in forest economics, wood products marketing, forest inventories and resource analysis. He served as coordinator on the study reported in this paper.

# ABSTRACT

The dollar and nondollar effects of alternative levels of residue utilization in mature lodgepole pine are compared.

Net dollar returns were greater in conventional logging (removal of green sawlogs to a 6-inch top, with slash piled and burned) than in near-complete harvesting (sawlog removal followed by field chipping of remaining wood material on the site). However, substantial nondollar benefits were gained by near-complete harvesting, especially in esthetics, fuel reduction, and site preparation. Continuing studies of harvesting influences upon soils, hydrology, nutrients, and regeneration will further define costs and benefits, and will provide managers with guidelines for harvesting practice decisions.

# CONTENTS



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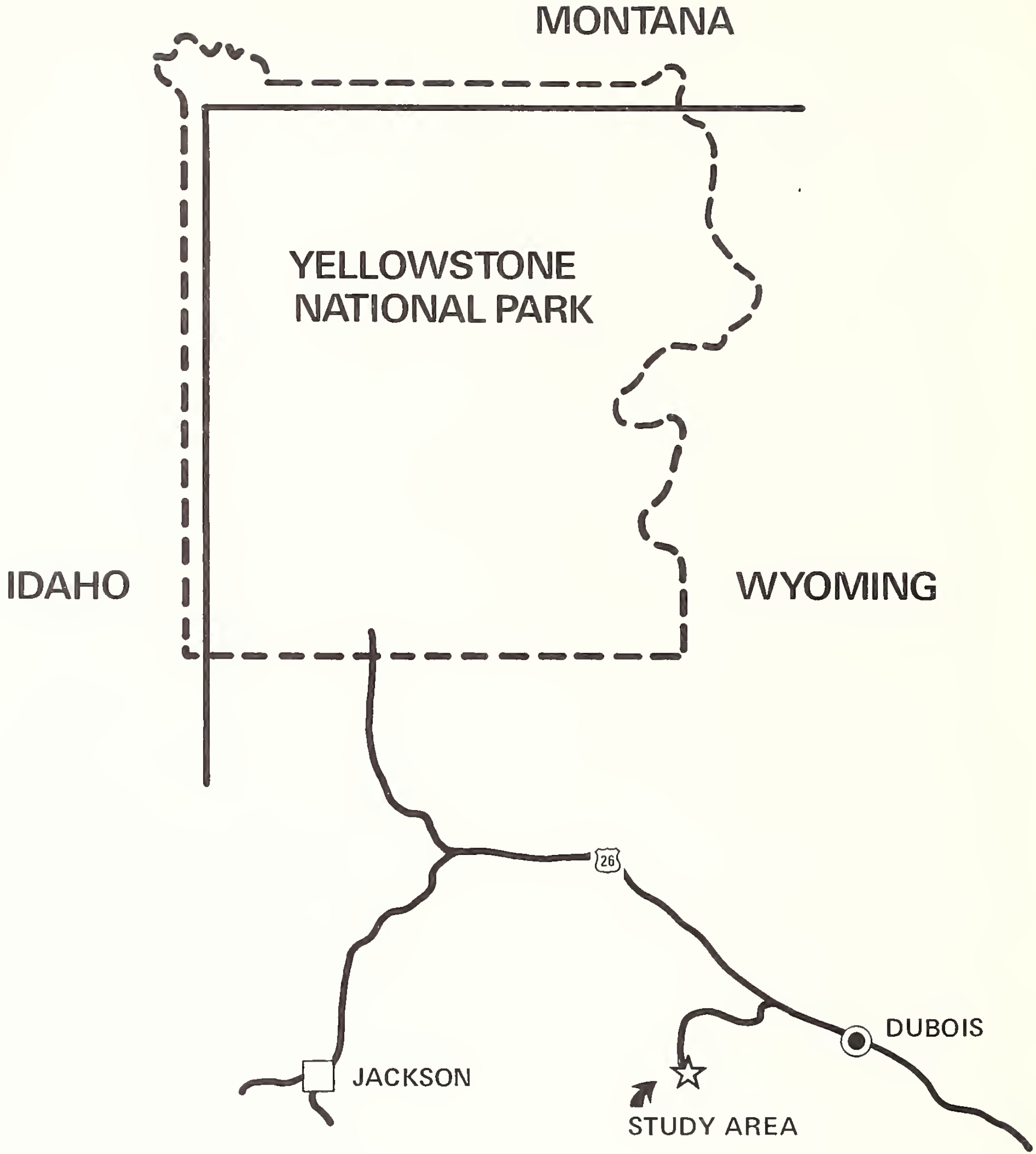


*Lodgepole pine stands in Wyoming were harvested to conventional wood utilization standards and to near-complete utilization standards so that the economic and environmental consequences could be compared. This report, one of many being published as phases of the study are completed, explores costs and esthetics of residue management.*

# INTRODUCTION

In recent years there has been a growing concern over timber harvesting practices and the disposal of the resulting logging residues. Although alternative methods of harvesting and handling residues have been suggested, there has often been a lack of information on the feasibility and on the effects these alternatives might have on the forest resource and its management, and on the environment, esthetics, and related matters.

In 1971, a study was begun to evaluate a system of harvesting mature lodgepole pine (*Pinus contorta* Dougl.) in which virtually all the logging residue--branches, tops, and dead and cull material--was yarded and chipped at the logging site. The study area is located in Wyoming near the Union Pass area of the Teton National Forest. U.S. Plywood Division of Champion International and the USDA Forest Service[1] cooperated in the study.

Presently, chips produced in the study cannot be marketed locally. A critical part of evaluating the feasibility of field chipping, however, is to determine the costs and evaluate the methods for logging and chipping. In addition, the environmental and esthetic effects of logging that removes nearly all the woody material from the land are of interest. These concerns coupled with the opportunity to cooperate among the participants led to this study.

## Description of Study

Four units of approximately 20 acres each were harvested by clearcutting. Two units were logged following conventional practices for that part of Wyoming. Green sawlogs to a 6-inch top were removed, and the remaining material was left for burning on the site ("green" includes recently dead trees that are sound). The other two units had "near-complete" removal; in addition to taking out the merchantable sawlogs, virtually all the remaining material was yarded and chipped. On the near-complete units, a feller-buncher and rubber-tired grapple skidder were used in connection with a mobile chipper (fig. 1). The equipment and the "near-complete" method of logging were new to the area.

The logging was completed in late fall of 1971. Postharvest treatments (described in detail later) were made in 1972 and 1973, and regeneration was completed (planting and seeding) in 1973.

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[1]Principal design and analysis of the study was by the Intermountain Forest and Range Experiment Station with the Teton National Forest, the Intermountain Region, and the Forest Products Laboratory cooperating. In 1973, the Teton National Forest was combined into the Bridger-Teton National Forest.

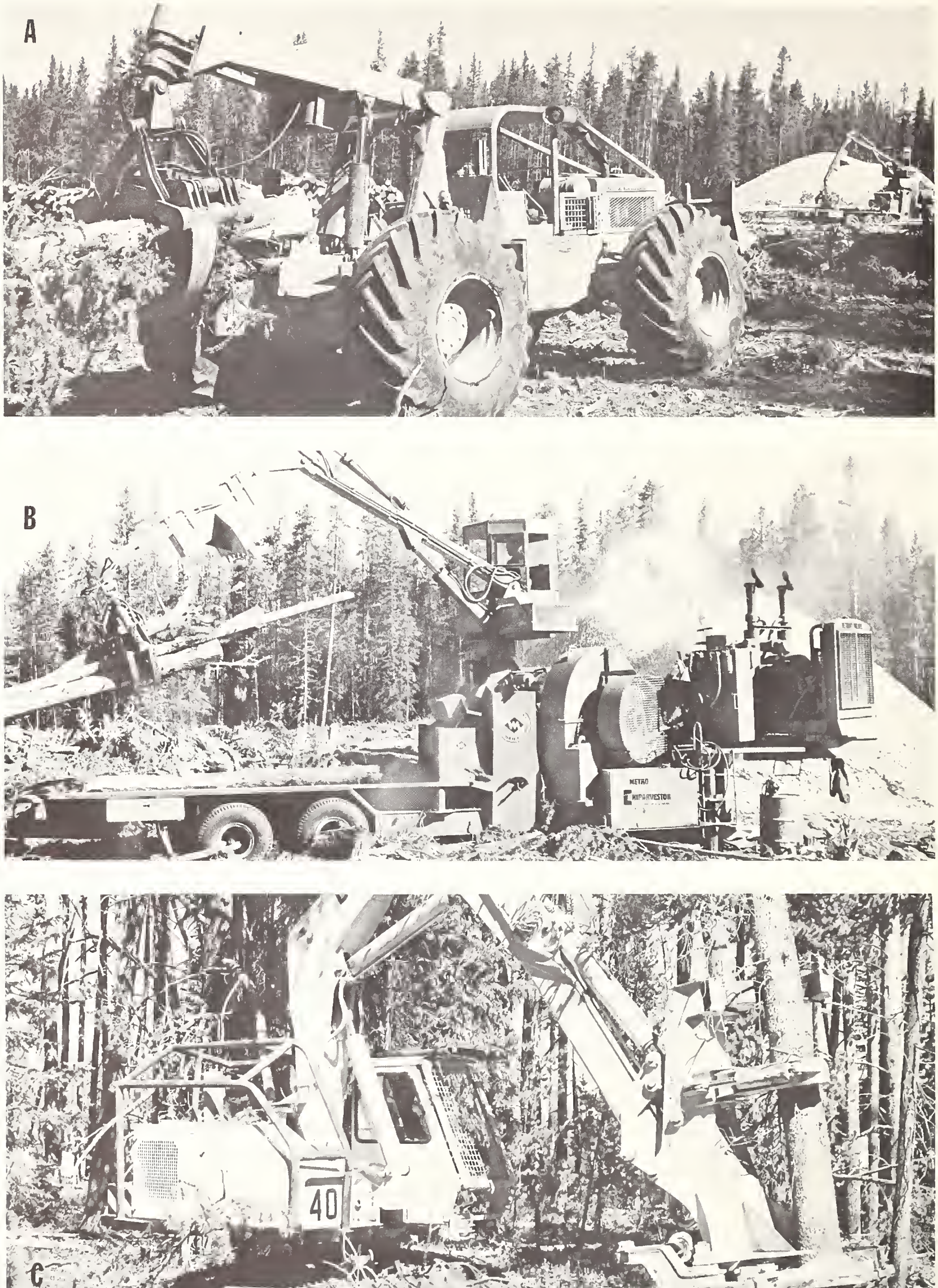


*Figure 1.--Equipment used in near-complete logging in lodgepole pine, Teton National Forest: A. Grapple skidder; B. chipper; C. feller-buncher.*

Evaluation of the logging areas involved a series of studies that focused on the following questions:

1. What kinds and amounts of residues remain after logging:

2. What products can be made from residues?

3. How can residues be removed efficiently for utilization?

4. What impact will removal of residues have upon regeneration and related management activities?

5. What impact will removal of residues have upon the environment, such as water quality, soil nutrients, esthetics, and wildlife?

6. What is the overall feasibility of residue removal, including both dollar and nondollar benefits and costs?

This report analyzes the benefits and costs of near-complete logging as compared with conventional logging. The results reported here must be considered in part preliminary because results for several phases of the research work will not be known until 8 to 10 years hence, and some effects of logging may still be operative several decades from now. A summary of initial benefits and costs is desirable, however, because there are many questions about the feasibility of alternative methods of dealing with logging residues that can be answered now. A discussion of this study in relation to timber harvesting problems was recently published (Galbraith 1972).

## Method of Analysis

This analysis includes both dollar and nondollar benefits and costs. The actual dollar values and costs observed in the study were adjusted to take into account certain variations in study conditions and to incorporate certain assumptions that illustrate the potential of near-complete harvesting. A net value per acre was then derived for the several logging and postharvest treatments involved.

Comparing nondollar costs and benefits was more difficult. Some phases of the study were measured in physical units that provide a standard for comparison. Other phases involved judgment values either because the study limitations did not permit more formal analysis, or in some cases because no acceptable quantitative measures are available.

This analysis compares both nondollar values and dollar values for different alternatives, through a method developed by Rickard and others (1967) (fig. 2). The method illustrates the different combinations of dollar and nondollar values for each alternative, but it should be understood that this does not attach a dollar value to different levels of nondollar values.

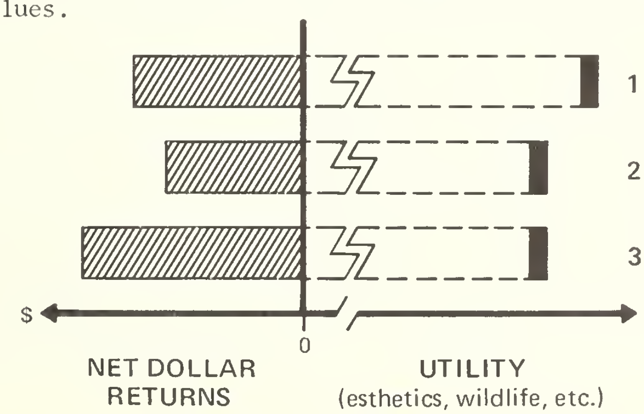


*Figure 2.--Simultaneous display model of dollar and nondollar values, harvest alternatives 1, 2, 3.*

# NET DOLLAR VALUES

The net dollar returns per acre used in this analysis are derived as follows:

Net dollar value = (value of products on truck at landing) minus (logging cost) minus (slash disposal cost) minus (site preparation and regeneration costs).

Several net values are derived to illustrate the range of values using different combinations of logging methods and product values. The alternatives are:

Product values--one sawlog value and two chip values.

Logging method--conventional vs. near-complete.

Slash disposal methods--near-complete removal, broadcast burn, and pile burn.

Regeneration method--planting, seed spots, and natural seeding.

The actual stand volumes per acre varied among logging units. Therefore, uniform volumes per acre were assumed so that cost comparisons would reflect treatment differences.

Because logging crews using new equipment were not working with maximum efficiency, a simulated improved logging operation is included as one part of the analysis.

## Value of Products

The value of products harvested was based on values of chips and logs loaded on the truck at the site. Because the timber sale was not appraised in the conventional manner, values were derived from another sale in the area. Sawlog values on the truck were $55.71 per thousand board feet (Mbf), and chips, measured in bone dry units (BDU), valued at zero. (There is no market at present for chips in the area). Applying these values to actual volumes harvested, the value per acre from conventional logging was $1,295 per acre, and from the near-complete logging $836 per acre. (table 1).

Part of the difference in product values per acre is due to initial differences in volumes on the areas logged. To adjust for this, the average volume for all the units in this study (20 Mbf/acre) was assumed for alternative analyses. Harvesting operations on the near-complete units recovered only about 80 percent of the estimated initial sawlog volume. This aspect of the near-complete logging operation is discussed in more detail by Gardner and Hartsog (1973). If all the sawlogs could be recovered, and if the uniform volumes of 20 Mbf per acre are assumed, then both methods would return $1,114 per acre for sawlogs.

Table 1.--*Values of products loaded on truck for actual study conditions and for assumed volumes*

| Logging | Sawlog: Mbf/acre | Sawlog: Value/acre @ $55.71/Mbf | Chips: Vol/acre BDU's | Chips: Value/acre @ $0/BDU | Chips: Value/acre @ $7.00/BDU | Total Value: Chips $0/BDU | Total Value: Chips $7.00/BDU |
|---|---|---|---|---|---|---|---|
| Actual: | | | | | | | |
| Conventional | 23.2 | 1,295 | -- | -- | -- | 1,295 | 1,295 |
| Near-complete | 15.0 | 836 | 47.7 | 0 | 334 | 836 | 1,170 |
| Assumed: | | | | | | | |
| Uniform volume with 80% sawlog recovery on near-complete | | | | | | | |
| Conventional | 20 | 1,114 | -- | -- | -- | 1,114 | 1,114 |
| Near-complete | 16 | 891 | 40 | 0 | 280 | 891 | 1,171 |
| Uniform volume with 100% sawlog recovery on near-complete | | | | | | | |
| Conventional | 20 | 1,114 | -- | -- | -- | 1,114 | 1,114 |
| Near-complete | 20 | 1,114 | 35 | 0 | 245 | 1,114 | 1,359 |

If chips had a value of $7.00 per 2,400-lb BDU[2] on a truck at the landing, then an additional $334 would have been obtained on the actual logging, based on 47.7 BDU per acre that were produced in the actual study. Under the assumptions of uniform sawlog volumes and 80 percent sawlog recovery, a slightly smaller volume of chips (40 BDU/acre) would have been derived, based on analysis of stand volume data. If 100 percent of the sawlogs had been recovered and uniform stand volumes are assumed, the volumes of chips would have dropped to about 35 BDU/acre; values would have been $1,359 per acre if chips were worth $7.00 per BDU.

## Logging Costs—Stump to Truck

The actual logging costs for sawlogs were $22.83 per Mbf on the conventional units and $23.07 per Mbf on the near-complete units. Chipping costs were $14.93 per BDU. Total costs were: conventional logging, $530/per acre; and near-complete logging, $1,058 per acre (table 2). When uniform volumes are assumed, the costs per acre are $457 for conventional logging and $966 for near-complete logging. If all sawlogs were recovered on the near-complete units, costs would be $984 per acre.

Logging more efficiently on the near-complete units reduces unit costs for both sawlogs and chips by about $230 per acre ($966 - $736 = $230 with 80 percent sawlog recovery; and $984 - $750 = $234 with 100 percent sawlog recovery).

## Slash Disposal

On the conventional logging units, two methods of slash disposal were used. Some slash was piled with a crawler tractor and the piles burned at a cost of $43.41 per acre; this is the usual method of slash disposal in the area. Other slash was broadcast

[2]Derived from $21.00 per BDU at a manufacturing plant (average chip price at western mills), less 10 percent screening loss, less $11.90 hauling cost from site to plant.

Table 2.--*Logging costs--stump to truck for actual study conditions and for assumed volumes and simulated logging operations*[1]

| Logging | Sawlogs: Vol/acre | Sawlogs: Cost/Mbf | Sawlogs: Cost/acre | Chips: Vol/acre | Chips: Cost/BDU | Chips: Cost/acre | Total cost/acre |
|---|---|---|---|---|---|---|---|
| | *Mbf* | *---Dollars---* | | *BDU* | *----------Dollars----------* | | |
| Actual Harvest (ave.): | | | | | | | |
| Conventional | 23.2 | 22.83 | 529.66 | -- | -- | -- | 530 |
| Near-complete | 15.0 | 23.07 | 346.05 | 47.7 | 14.93 | 712.16 | 1,058 |
| Assumed: | | | | | | | |
| Uniform Volume | | | | | | | |
| Conventional | 20 | 22.83 | 456.60 | -- | -- | -- | 457 |
| Near-complete (80% sawlog recovery) | 16 | 23.07 | 369.12 | 40 | 14.93 | 597.20 | 966 |
| Uniform Volume | | | | | | | |
| Conventional | 20 | 22.83 | 456.60 | -- | -- | -- | 457 |
| Near-complete (100% sawlog recovery) | 20 | 23.07 | 461.40 | 35 | 14.93 | 522.55 | 984 |
| Favorable logging | | | | | | | |
| Conventional | 20 | 22.83 | 456.60 | -- | -- | -- | 457 |
| Near-complete (80% sawlog recovery) | 16 | 17.70 | 283.20 | 40 | 11.33 | 453.20 | 736 |
| Favorable logging | | | | | | | |
| Conventional | 20 | 22.83 | 456.60 | -- | -- | -- | 457 |
| Near-complete (100% sawlog recovery) | 20 | 17.70 | 354.00 | 35 | 11.33 | 396.55 | 750 |

[1]Costs per unit of product derived from Gardner and Hartsog 1973. Volumes per acre from Gardner and Hann 1972, and from assumed volumes.

burned with no treatment except that a fireline was made with a crawler tractor at a cost of $18.67 per acre (table 3). Although the broadcast burning costs less than piling and burning, favorable burning conditions are limited in duration. (A more detailed discussion of broadcast burning is presented later.)

On the near-complete logging area, part of the slash was left "as is" after the logging, with no further cleanup. In the analysis that follows, this treatment is assigned zero cost (but alternatively a portion of the logging cost could be assigned here). On part of the area, chips were spread back on the ground about 4 to 6 inches deep to study the effects on planted seedlings, soil nutrients, and so on.[3]

[3]The method of putting chips on the ground would not likely be used in general practice; therefore, the actual costs incurred are not included in the analysis.

Table 3.--*Costs of postharvest activities*

| Activity | Conventional: Broadcast burn | Conventional: Pile and burn | Near-complete: "as is" | Near-complete: Chips spread |
|---|---|---|---|---|
| | *Dollars per acre* | | | |
| SLASH TREATMENT | | | | |
| Piling/fireline | 4.86 | 35.71 | 0 | 0 |
| Burning | 11.33 | 1.94 | 0 | 0 |
| Overhead | 2.48 | 5.76 | 0 | 0 |
| Total costs | 18.67 | 43.41 | 0 | 0 |
| REGENERATION | | | | |
| Natural seeding | 0 | 0 | 0 | 0 |
| Planting[1] | 122.89 | 133.48 | 156.92 | 146.00 |
| Seeding[1] | 75.33 | 61.12 | 66.93 | 53.05 |
| REGENERATION AND PROTECTION, TOTAL COSTS[2] | | | | |
| Natural seeding | 64.50 | 64.50 | 64.50 | 64.50 |
| Planting | 187.39 | 197.98 | 221.42 | 210.50 |
| Seeding | 139.83 | 125.62 | 131.43 | 117.55 |

[1]Includes stock and seeds, overhead, and mouse control.
[2]All totals include \$61.50 per acre, cattle fencing; \$3/per acre, gopher control.

## Site Preparation and Regeneration

Three regeneration methods were used on the logging units: planting 2/0 trees (700/acre), seed spots (10 seeds/spot, 1,000 spots/acre), and natural regeneration. Ground cover was "scalped" with a McCloud tool or hazel-hoe, then auger-planted or seeded with a panama seeder. The costs per acre are shown in table 3.

The differences in planting and seeding costs reported may in part be due to different treatments, but because there were only two replications, it was not possible to isolate other variables (weather conditions, training of crews, etc.). Actual costs are used here, but it is likely that over many replications cost differences between treatments would be small or not significant (see later section on regeneration).

The regeneration costs apply only to the initial planting and seeding. If new trees fail to become established and subsequent replanting or reseeding is required, regeneration costs would need to be revised upward. For comparison, in 1972, on the Teton National Forest average regeneration costs were \$178 per acre (site preparation and planting), and the survival rate at 1 year about 82 percent.[4]

[4]Memo of May 24, 1973, 2470 Silvicultural Practices, Assist. Reg. Forester, Timber Management, Ogden, to Forest Supervisors, Table A.

Seeding on the adjacent Bridger National Forest had 64 to 72 percent stocked seed spots after 3 years, using methods like those in this study (Lotan and Dahlgreen 1971).

## Summary of Dollar Values

When values and costs presented above are summed to net dollar values, several dozen possible combinations could be made and would show a wide range in dollar values (fig. 3). Actual values on the near-complete units average -$443 per acre. At the other extreme, values for near-complete logging assuming uniform volumes, 100 percent recovery of sawlogs, most favorable logging conditions, and chip values from conventional logging are greater than from near-complete logging under all conditions analyzed.

For purposes of the display model, only one set of net values is used. (Appendix table 4 shows alternative values that could be inserted in the dollar side of the model). Values used are based on uniform volumes per acre, 100 percent sawlog recovery, and $7.00 per BDU chip value. It is assumed that near-complete logging of this kind would not be undertaken unless the chips would be removed and utilized, and that sawlog values are such that every effort would be made to recover all merchantable sawlogs.

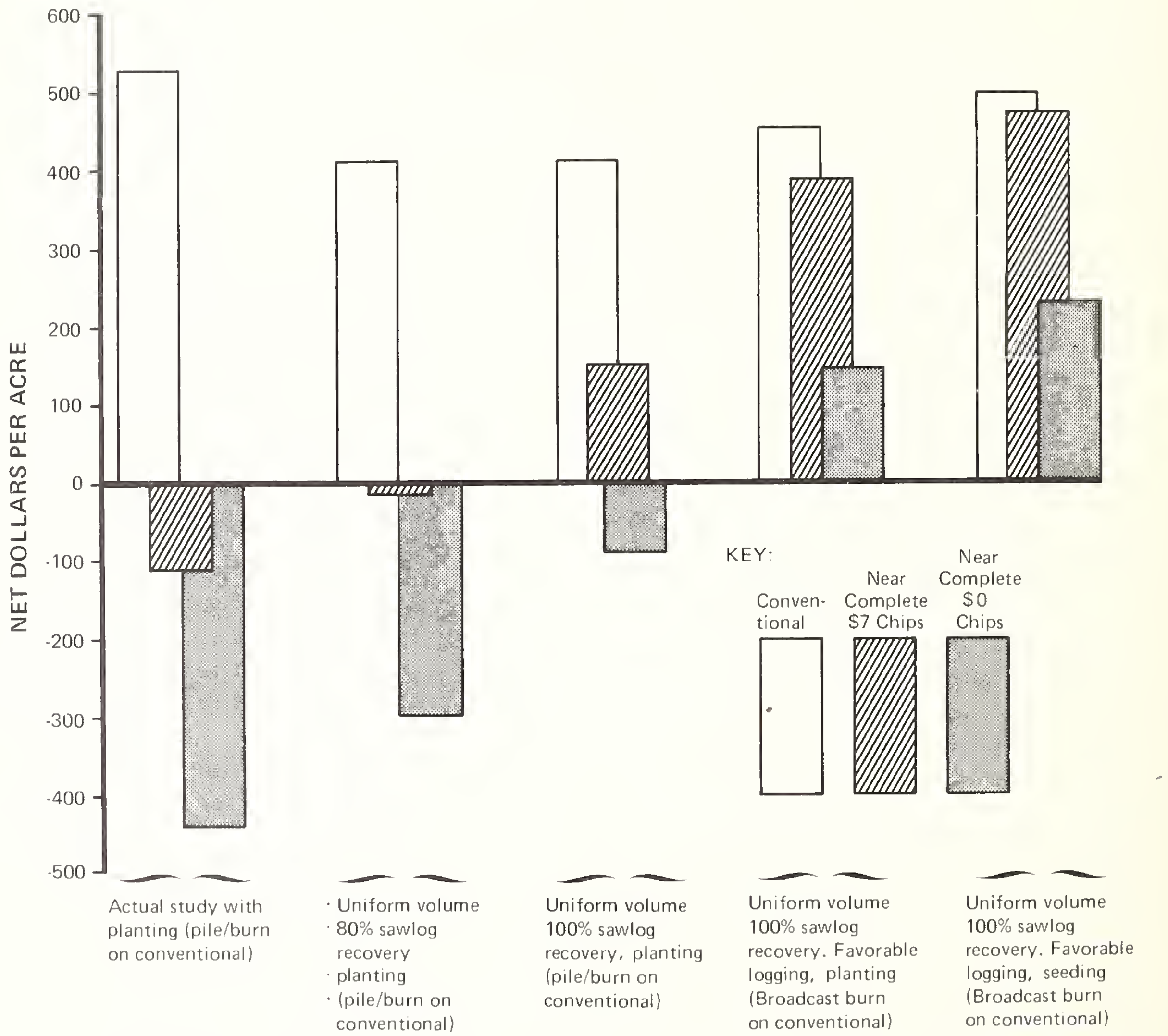


*Figure 3.--Net dollar values per acre for various logging and postharvest treatments.*

Piling and burning is used in the conventional logging, and planting is assumed on both conventional and near-complete logging sites. Broadcast burning and either seeding or natural regeneration might reduce costs, but at present these methods are not generally used. The net values per acre used in the remaining analyses are:

| *Conventional* | *Dollars per acre* |
|---|---|
| Product value | 1,114 |
| Logging cost | -457 |
| Slash disposal (pile/burn) | - 43 |
| Regeneration (planting) | -198 |
| Net dollar value per acre | 416 |

| *Near-complete* | | | |
|---|---|---|---|
| Product value | (chips = $7) 1,359 | (chips = $14.50) | 1,621 |
| Logging cost | -984* | | -984 |
| Slash disposal | 0* | | 0 |
| Regeneration (planting) | -221 | | -221 |
| Net dollar value per acre | 154 | | 416 |

*Alternatively, logging cost could be $984 - $43 = $941, and slash disposal could be $43. Net values per acre would remain the same.

If chip values were $14.50 per BDU, the net dollar value per acre of conventional and near-complete logging would be the same.

These net dollar values are shown in the display model in figure 4. The value of "no harvest" (assumed to be zero) and of chip spread treatment (a negative value of some indeterminant amount) are also shown because an esthetic evaluation and some other evaluations were made for these treatments.

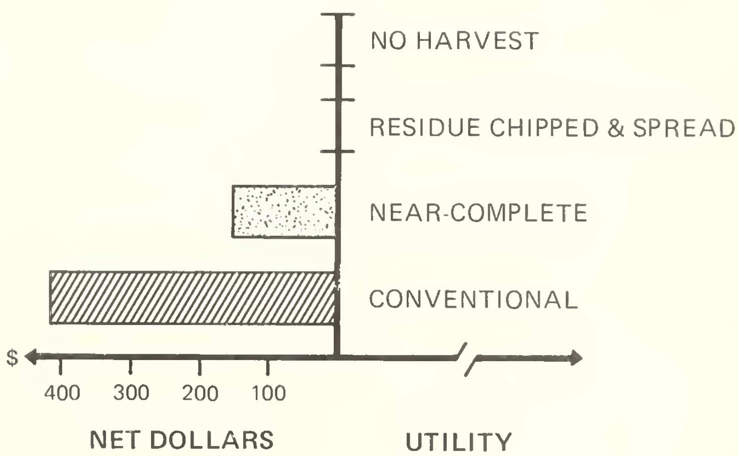


*Figure 4.--Net dollar values of alternative harvest and post-harvest activities.*

# ESTHETIC EVALUATION

A prime objective of this study was to compare the logging and residue treatments in terms of esthetics. Since the principal concern is for differences among treatments, evaluation was based on the viewpoint of an observer hiking or driving alongside the harvested units. No evaluation was made of the distant-view esthetics, such as how well the units conformed to the general landscape; these are of course important for any logging or treatment used.

Two types of esthetic evaluations were made. In one evaluation, Forest Service landscape managers appraised the area. Two facets were considered: a general evaluation of different treatments to provide a numerical rating, and an analysis of specific features within the units.[5] This is referred to as "manager's evaluation." The other evaluation was made by university students who viewed slides taken at random in each of the areas and rated them as to degree of "like" or "don't like." This is referred to as "laymen's evaluation."[6]

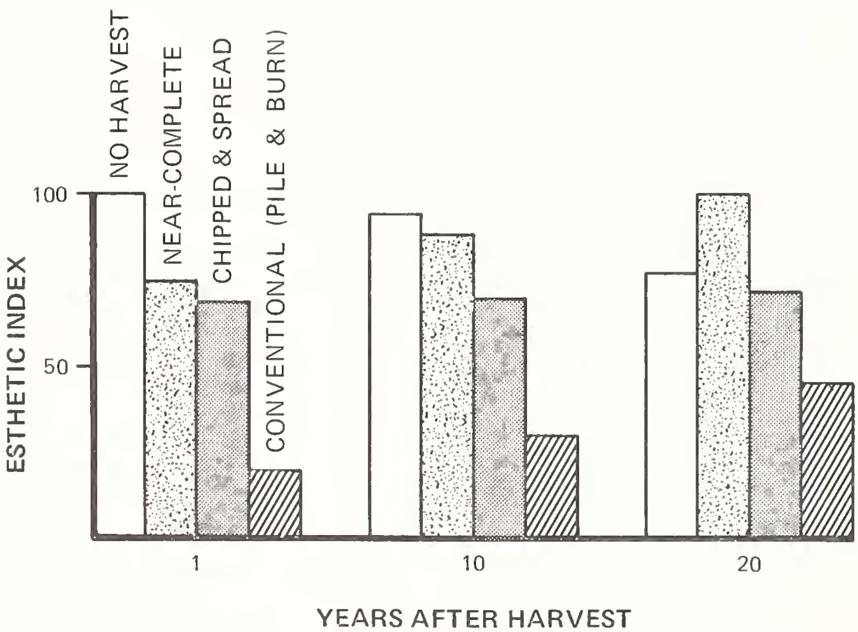


*Figure 5.--Manager's esthetic evaluation, mature lodgepole pine stands (vantage point: driving by area, foreground).*

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[5]General evaluation was made by Reed Stalder, landscape architect, Intermountain Regional Office, Ogden, Utah. Analysis of features was made by Walt Grubic, landscape architect, Teton National Forest.

[6]This evaluation was made by Ron Boster, Rocky Mountain Forest & Range Exp. Station, Tucson, in conjunction with staff members in the Dep. Psychology, Univ. Arizona, using Theory of Signal Detectability Techniques. Laymen were drawn from university students.

## Manager's Evaluation

The manager's rating of treatments is shown in figure 5 and compares an uncut old-growth stand, conventional (pile and burn) cleanup, near-complete (residue removed), and chips spread over the ground. In addition to the rating immediately after harvest (year 0), projections were made as to esthetic response 10 and 20 years hence.[7] The evaluation was based on what would be seen when driving by the areas. Other evaluations were made for activities such as 1-day visits, and other recreation activities. In general, the relationship between treatments was about the same, although activities in which the observer was at the area for some period of time rated lower than for the observer just driving by.[8]

The uncut old-growth stand rated highest at the year of harvest, but is expected to decline over time, as tree mortality and blowdown bring a more ragged and dilapidated appearance. Near-complete residue removal areas rated fairly high after harvest and, assuming normal regeneration, are expected to reach a high (100 index) level in 20 years. Pile-and-burn areas also are expected to show recovery, but will remain below the esthetic values of the near-complete residue removal areas.

The comparison of the pile-and-burn vs. residue-removed treatments noted several features:

1. Near-complete units had an overall clean look compared to cluttered look of pile-and-burn units.

2. Soil disturbance on near-complete units was not excessive, but on piled areas created visual discord.

3. Low stumps on the near-complete units (resulting from the shearing near groundline by the feller-buncher) created less discord than stumps on the conventionally logged pile-and-burn unit.

4. Good herbaceous cover was retained on the near-complete blocks, which kept the color tone compatible with surrounding area.

These factors tend to substantiate the higher ratings given to the near-complete unit. The near-complete unit rated higher than the conventional unit for all the other vantage points and types of use that were used in the evaluation.

Using the model outlined earlier, the esthetic values and dollar values are displayed in figure 6.

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[7]Projections for 10 and 20 years hence are based on the expectation that plant succession and growth will be similar to that in adjacent areas where development following disturbance has been observed.

[8]Complete results are not shown here, but are summarized in Office Report "Wyoming logging residue study, esthetic and recreation evaluation," by Reed Stalder, on file at Intermountain Forest & Range Exp. Station, Forestry Sciences Laboratory, Missoula, Montana.

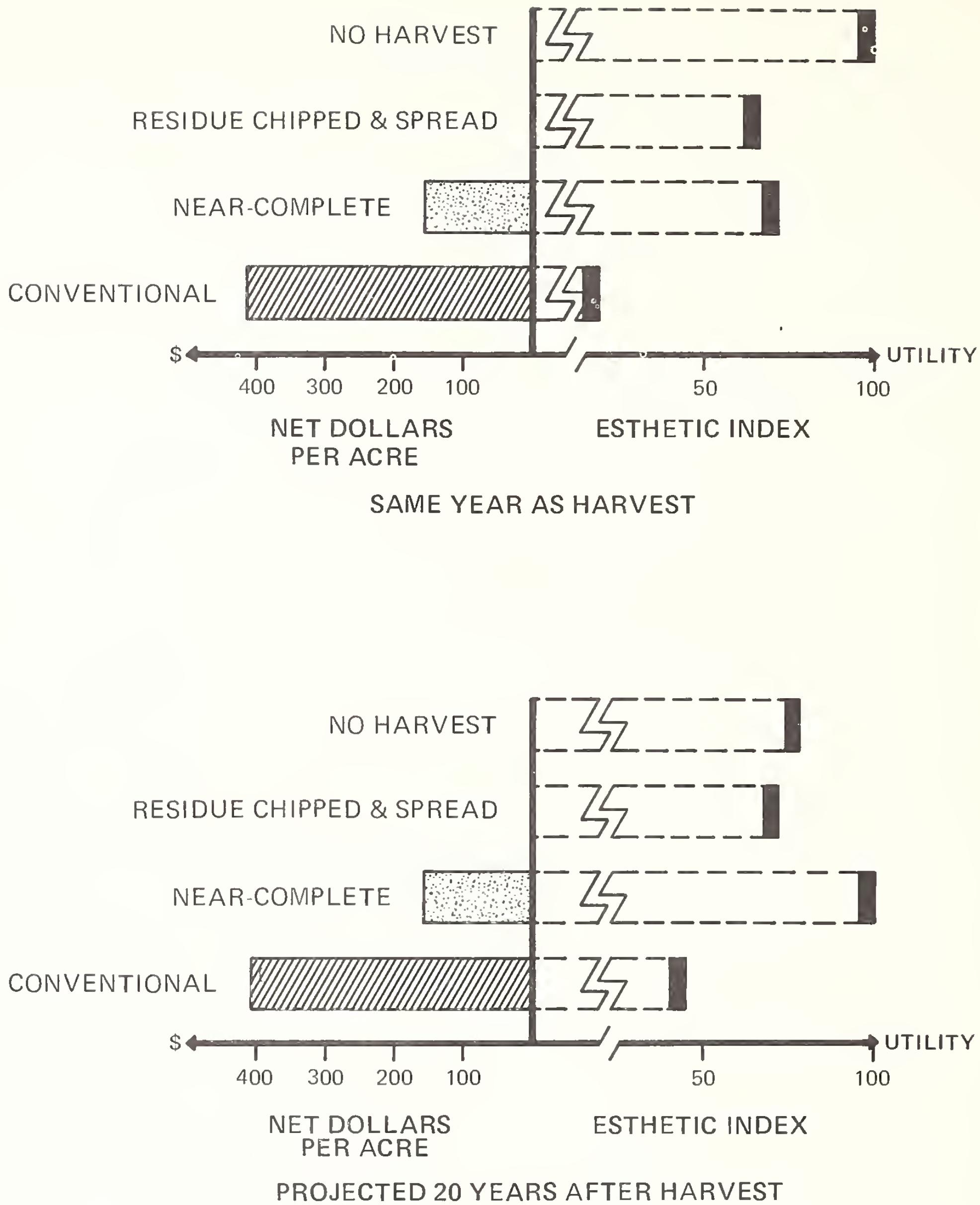


*Figure 6.--Net dollar values and manager's esthetic evaluation.*

## Laymen's Evaluation

In the laymen's evaluation, slides of six different "treatments" were shown to panel groups and their ratings for each slide were recorded. The treatments included: a meadow-forest edge, which served as a benchmark because of its known high esthetic appeal; a pile-and-burn area 5 years after treatment; near-complete removal; chip-spread area; pile-and-burn 1 year after treatment; and an uncut stand.

The raw data obtained from the laymen's evaluation are presented in the following tabulation. The median rating means half the viewers rated the treatment higher, and half lower than the value shown. (These values are based on a 0 to 9 ranking, with 0 = strong dislike, 9 = strong like, 4 = just guessing "I dislike," 5 = just guessing

"I like," etc.). The scenic value estimator (SVE) score is a measure of dislike of a particular treatment when compared to the most pleasing (meadow-forest edge), which was set at zero. The SVE score is a statistically unbiased standardized measure of people's relative preferences for a given treatment (Boster and Daniel 1972; Daniel and others 1973).

The ratings below are averages of values given by two groups of laymen:

| | *SVE* | *Median* | *Median Index* |
|---|---|---|---|
| Meadow edge | 0 | 8.00 | 100 |
| Unharvested forest | .65 | 5.85 | 73 |
| Pile & burn, 5 years after | 1.10 | 4.25 | 53 |
| Near-complete removal | 1.30 | 3.65 | 46 |
| Chips spread | 1.30 | 3.90 | 49 |
| Pile & burn, 1 year after | 1.75 | 2.15 | 27 |

The median ratings are not directly comparable to the SVE scores, but these two measures do show approximately the same relationships among treatments. To make the laymen's rating comparable with the manager's rating, the median rating was converted to a 0-100 scale index. The laymen's esthetic indexes are shown with dollar values in figure 7.

Admittedly, esthetic measurements like those shown above cannot be precise. It is significant, however, that the general ratings of these treatments by both laymen and managers are similar.

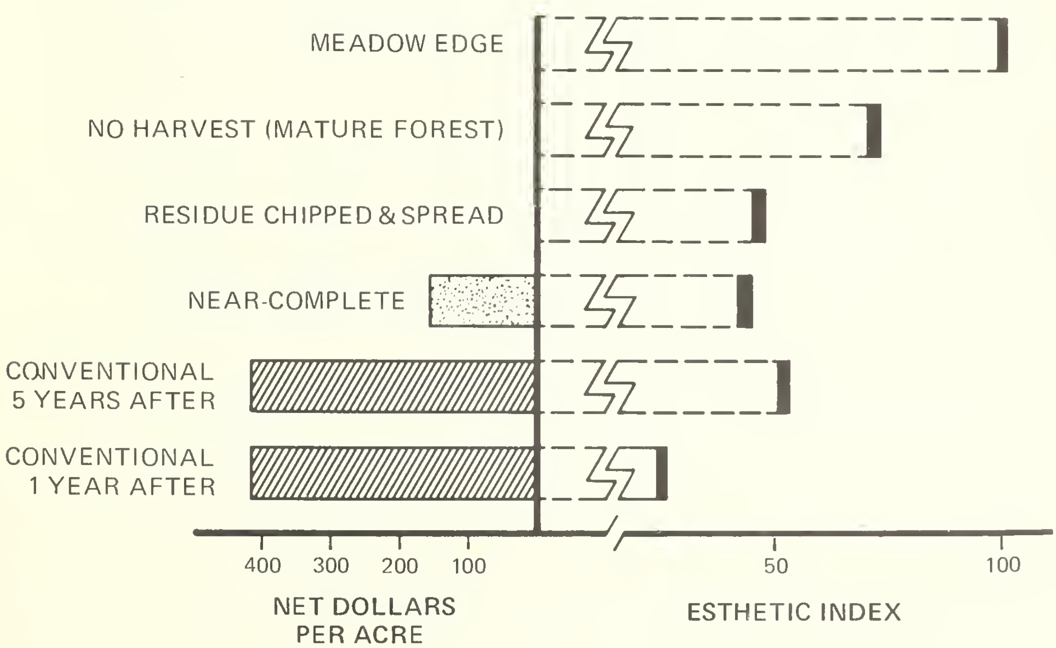


*Figure 7.--Net dollar values and laymen's esthetic evaluation.*

# WILDLIFE EVALUATION

In 1972, the Teton National Forest Wildlife biologist evaluated the areas in terms of effects on wildlife. Field sampling and observations of both wildlife and vegetation were combined into an index value for three time periods (at harvest, 20 years hence, and 100 years hence).[9] The ratings developed for moose, elk, and birds for three treatments are shown in figure 8. Additional analyses of vegetation counts and of other treatments are summarized in an unpublished report.[10]

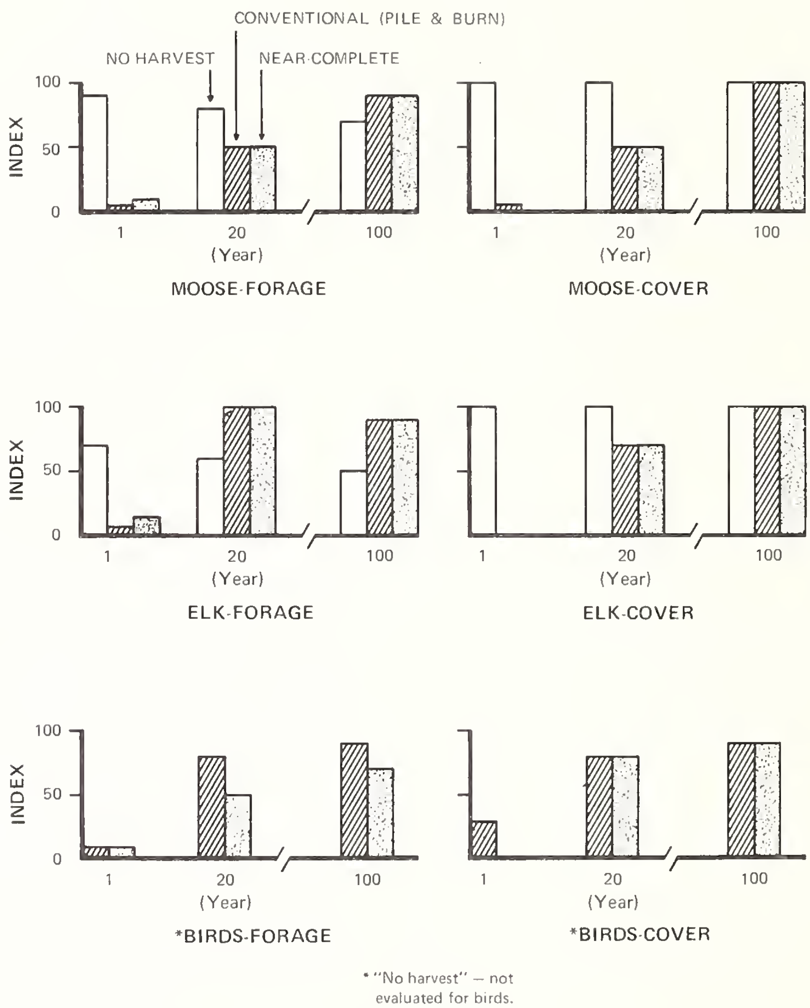


*Figure 8.--Wildlife index values at harvest and projected 20 and 100 years hence.*

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[9]Projections for 20 and 100 years are based on the expectations that plant succession will be similar to that of adjacent areas, and further assumes that other things remain equal.

[10]Processed report under cover letter of George Gruell, Wildlife Biologist, Teton National Forest to Jack Hougaard, Regional Planner, Ogden, Utah, June 15, 1973.

For moose and elk, principal game animals of the area, the two postharvest treatments were virtually the same in terms of forage and cover. Unharvested stands are superior to both harvesting treatments in terms of cover, but over time forage is projected to increase on harvested areas and decrease on unharvested stands. Habitat in piling and burning areas was superior to near-complete removal areas-in providing perching places and in the amount of food produced. Potential damage by pocket gophers was also evaluated; this is discussed in the regeneration section.

Although these evaluations were of necessity largely subjective, both postharvest treatments were judged to offer little forage and cover for big game. The chip-spread areas were judged to offer even less in vegetation response and wildlife potential. On the other hand, within 20 years both treatments are projected to make substantial response in cover, and are expected to surpass unharvested areas in forage produced.

The utility index values and dollar value comparisons vary among wildlife species and time period but figure 9, based on elk forage and cover, could be considered a representative basis for comparison.

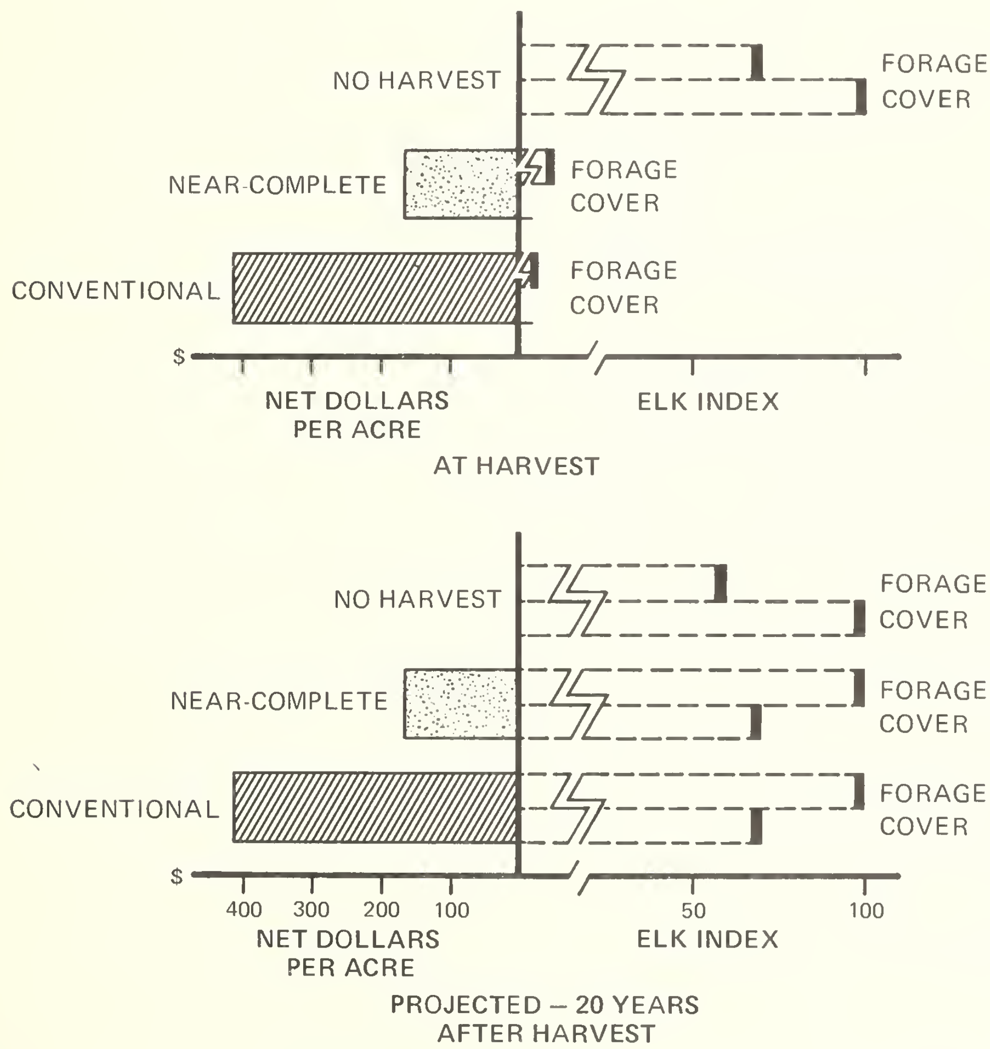


*Figure 9.--Net dollar value and elk utility index at harvest and 20 years hence.*

# PRELIMINARY REGENERATION EVALUATION

Seeding and planting were completed in June 1973. Although it is too early to adequately evaluate effects of treatments on regeneration, certain items are now evident.

The costs of planting or seeding the four treatments are probably not significantly different. Weather conditions, training of crews, and other factors have entered in differences reported here.

Overall, seedling survival the first growing season was high--over 95 percent for all areas planted. Germination of the spring-sowed seed spots was delayed until well into August. On the average there are two to three germinates per seed spot and about 55 percent of the spots are stocked, but results are highly variable.

The spreading of chips as an alternative to burning could present problems. Soil-surface temperatures will probably be significantly lower on areas spread with chips than on other treatment areas, and this is going to affect seedling development on this high elevation site.

Regeneration and survival in this area are affected by pocket gophers, which gnaw the roots of young seedlings, and by various seed-eating rodents and birds.

First-year observations on both the near-complete and conventional units showed few pocket gophers within the units. In addition, seed-eating birds and animals, particularly red squirrels and chipmunks, were mostly seen on the edges of the units. Future evaluations will be needed to learn if there are differences in regeneration between the two logging systems that can be attributed to birds or animals.

If these initial observations hold throughout the next few years, the differences between treatments will be small in terms of dollars, and except for the chip-spread areas, nondollar values (i.e., survival and possibly, growth) will also be similar. In other words, the utility index "bars" on the model should remain about the same.

On the other hand, if subsequent years show differences in growth or survival, then the utility indexes should be adjusted. If survival were unsatisfactory and replanting or reseeding were needed, these results could also be incorporated directly in the net dollar values.

# FUELS, FIRE HAZARDS, AND BURNING

Following logging and before any cleanup work, fuels and fire hazards were compared for the two treatments. Preharvest and postharvest inventories on the amounts and compactness of fuels provided data that were used to predict fire intensity and rate of spread (Brown 1974).

The weight of fuels on the ground on the near-complete units was reduced to about one-third of the preharvest level, and increased about three times on the conventional units. The amount and compactness of fuel used as inputs for a mathematical fire model indicate that on the conventionally logged area (before any piling of slash) the rate of spread would be about 4-1/2 times greater and the intensity about 3-1/2 times greater than on near-complete harvest areas.

In practical terms this means that some type of slash treatment would likely be needed to reduce hazard on slash left after conventional logging, but it would not be needed on near-complete areas. If prescribed burning were desired for regeneration or other purposes, however, the near-complete areas would be difficult to burn.

The principal nondollar factors considered in burning vs. not burning are soil disturbance in piling, air quality, heat damage to adjacent stands, and the risk of a fire escaping control.

Assessing impact of piling on the hydrology, soil micro-organisms, and nutrients will require several years of observation. The esthetic evaluation noted, however, that disturbances such as pushing dirt into the slash and gouging the ground detracted from the appearance of the piled units. This is a common occurrence in piling, particularly if the ground is wet.

If smoke from slash burning was highly intolerable to people in the area, then the near-complete logging would have infinitely greater utility. Either there would be laws against such burning or managers would simply not choose to burn. This is not the case in the study area. The location and the air movements are such that under normal conditions only the few people visiting this rather remote area would be aware of the burning. Because of this, there is probably no significant difference in utility between burning and not burning as far as smoke is concerned.

Along the edges of the areas that were broadcast burned, some trees were scorched, but not on a scale that would be of concern. The probability of an escape fire is small because managers would not be burning under hazardous conditions and because fires seldom occur in these high-elevation lodgepole stands. Broadcast burning is not commonly used in the area, however, because seldom are burning conditions favorable enough to produce desired results.

Taking these factors into account, near-complete logging with no burning may have some indeterminate but small advantage over burning. This assumption is modeled in figure 10.[11] This analysis assumes that burning would be avoided under conditions that

[11]The analysis of burning is based on observations by Rod Norum, Northern Forest Fire Laboratory, Missoula, Montana, on burning conditions and prescription (Wyoming residue study burn prescription, April 3, 1972, memo) observations of Teton National Forest personnel, and personal observations of burning and postburn conditions.

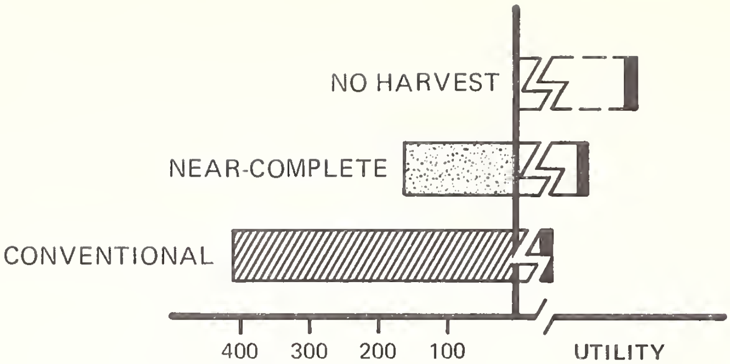


*Figure 10.--Dollar values and utility index of hazard reduction and burning.*

were either too wet or too dry, windy, or otherwise hazardous. It should be recognized also, that this analysis applies only to the fuels and burning aspects. Wildlife and esthetic values are affected by the fuels treatment but these values are incorporated into the model elsewhere.

# HYDROLOGY, SOIL, AND NUTRIENTS

A critical part of this study is to determine the effect of near-complete utilization on the soil and water regimen. Several studies are underway and will continue to 1976 or 1977. These include analysis of soil structure and properties, soil chemistry and biochemistry, nutrients, hydrologic and erosional behavior, and vegetal characteristics.[12]

These studies have two goals: (1) comparing near-complete logging with conventional logging in terms of soil compaction and disturbance, and (2) learning how removing a large part of the stand affects the nutrient system.

This information is extremely important to land managers charged with both the protection of the environment and the production of timber products from forest lands. Therefore, the benefits and costs outlined in this report could be altered if the two harvesting systems have markedly different impact on soil, water, and nutrients.

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[12]Detailed study plans on file at Forestry Sciences Laboratory, Logan, Utah:
Evaluating hydrologic and soil stability effects of logging residue disposal in lodgepole pine forests in Wyoming (Paul Packer)
Regeneration of lodgepole pine and nutrient status of areas logged with varied utilization standards in Wyoming (James Lotan)
Appendix A--Nutrient sampling (Norbert DeByle)
Appendix B--Effects of chemistry on soils and subsurface water (Alvin Southard, Richard Hawkins, George Hart, and Norbert DeByle)
Appendix C--Effects on biochemistry of soils (John Skujins and Norbert DeByle).

# UTILIZATION OF RESIDUES

A major objective of this study was to examine the feasibility of using the logging residues. Because there is no chip-using industry in the area, it was not possible to follow through on an operational basis; however, the Forest Products Laboratory evaluated suitability of the chips for various wood products.

Several particleboards were made from residues, including a three-layer structural board that was 50 percent slivers from the field-chipped residues and 50 percent flakes from roundwood bolts (fig. 11). Initial tests indicated that structural boards can be readily manufactured from lodgepole pine residue (Heebink 1974).

Residues from the area were characterized in terms of live and dead material, and volume of wood and bark. As shown by the following tabulation, the residues 3 inches

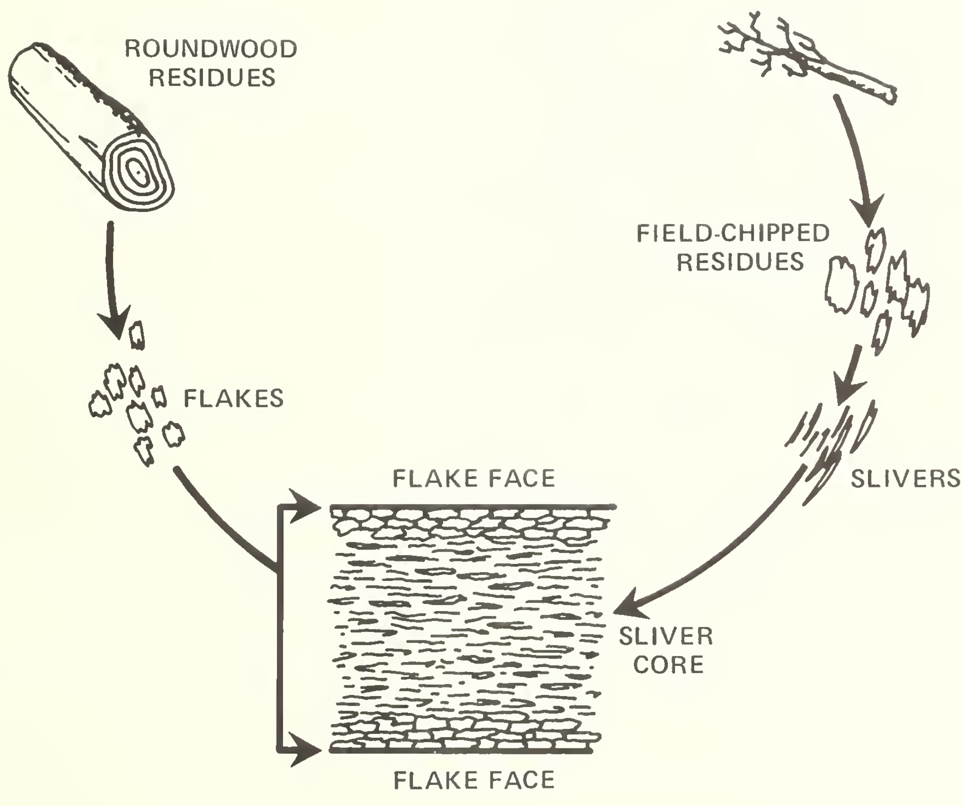


*Figure 11.--Three-layer lodgepole pine particleboard made from 50 percent slivers from field-chipped residues (Forest Products Laboratory).*

in diameter and larger had about 9 percent bark by volume, and the smaller size material had somewhat more bark (Foulger and Harris 1973).

| *Diameter size class* | *Residue volume* | | |
|---|---|---|---|
| *(Inches)* | *Wood* | *Bark* | *Total* |
| | - - - - - - - -$Ft^3$ *per acre*- - - - - - - | | |
| <0.3 | 2.4 | 5.7 | 8.1 |
| 0.3 to 0.6 | 69.3 | 41.2 | 110.5 |
| 0.6 to 3.0 | 562.7 | 84.8 | 647.5 |
| >3.0 | 3,274.5 | 292.5 | 3,567.0 |
| Total | 3,908.9 | 424.2 | 4,333.1 |

With current operating practices, most pulp mills would desire some separation of bark and chips for making paper. The technical requirements and economic feasibility of pulping chips were beyond the scope of this study. Because lodgepole pine wood has good pulping properties, pulping is a potential use for field residues.

Chips spread on a work road at the logging site made it easier to drive over spots that collected water. However, the chips held frost and moisture longer than adjacent bare ground. Chips hauled to a local rodeo ground and a campground provided a clean cover that reduced dust during the 2 years observed.

The benefits and costs of utilizing the residues have largely been incorporated in the cost analysis section. In addition to the direct costs and returns, the extent to which residues can be manufactured into substitutes for lumber and plywood, both in heavy demand, will be of interest. A given acre of lodgepole pine might produce not only the dimension lumber for framing a house, but also much of the panel material needed for sheathing. Additional testing and market development would be needed to implement structural lodgepole pine particleboard, a potentially important and promising way to utilize these residues.

Assuming that wood fiber is equally useful for different types of structural materials, the percentage of fiber recovered can provide a simple utility index.[13] In the study area, the total volume of fiber for different logging methods averages about 10,000 $ft^3$ per acre. In conventional harvesting, about 65 percent of this material was removed; in near-complete harvesting, about 97 percent. Figure 12 shows an index of fiber use under these alternatives.

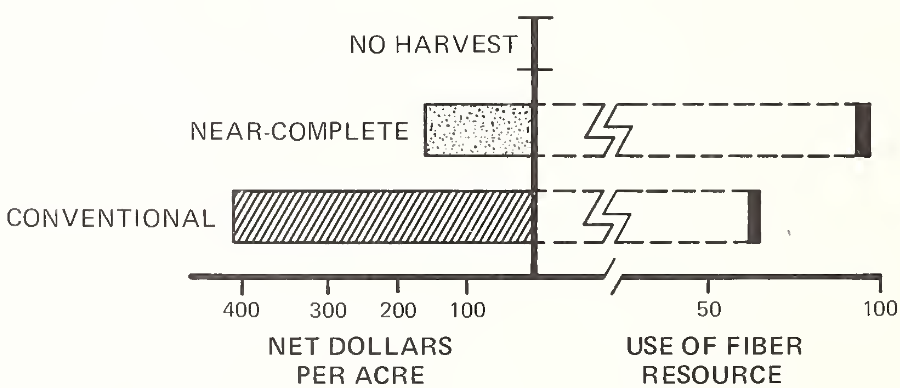


*Figure 12.--Index of utilization of wood fiber.*

[13]The price per cubic foot of lumber, plywood, or particleboard varies with grade, markets, etc., but can be considered reasonably close to equal for materials that would be used in most construction.

# SUMMARY

Analyses have compared nondollar values with the net dollar values of different harvest and postharvest alternatives. Individual nondollar values can now be brought together and displayed simultaneously to form a composite model (figure 13).

It must be remembered, however, that the nondollar values expressed along a utility index from 0 to 100 do not necessarily have equal importance. In a given situation, for example, the wildlife considerations may overshadow any of the other nondollar values involved.

When this happens, quantitative analysis must stop and the judgment of the land manager must take over. The model has systematically displayed the various dollar and nondollar benefits and costs, recognizing a given value. The meaning and the weighting of each must be tied to specific situations. A similar type of logging applied with different species, terrain, or other conditions could greatly alter both the dollar and nondollar values observed in this study. In addition, several of the crucial factors cannot be fully evaluated for several years.

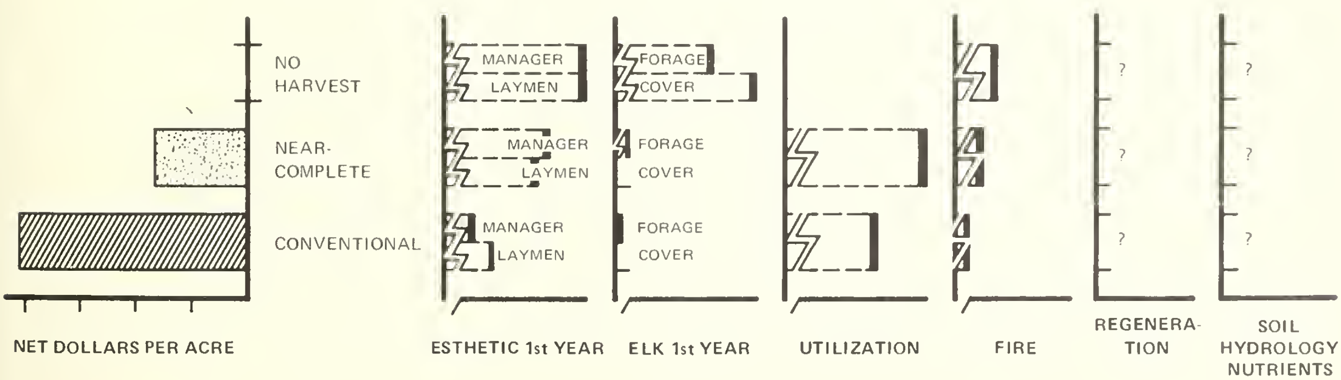


*Figure 13.--Dollar and nondollar values of no-harvest, near-complete logging, and conventional logging.*

The study does, however, provide a method for comparing conventional and near-complete logging over much of the mature lodgepole pine forests of the Mountain States and Canada.

The following are principal findings of the study:

1. It is technically feasible to chip most of the logging residues at the logging site; the chips are suitable for manufacturing wood products such as particleboard.

2. Dollar cost of converting residues to chips in the field was greater than dollar returns for chips alone, even if higher chip values are assumed and more efficient logging operations were attained. This illustrates the importance of recovering merchantable sawlogs, even where residues are chipped.

3. Net dollar value of conventional logging is greater than that of near-complete logging over the whole range of assumptions and alternatives analyzed, but the difference diminishes as logging and regeneration conditions improve.

4. In the set of conditions chosen for analysis as a practical and attainable operation the near-complete logging returned $262 per acre less than conventional logging. This means that any nondollar values gained in the near-complete logging would have an opportunity cost of $262 per acre. If chip values are $14.50 per bone dry unit, however, the two methods have equal dollar return.

5. The no-harvest alternative is superior to either conventional or near-complete logging in terms of esthetics and wildlife (using elk as a basis).

6. Esthetic and utilization values are higher on the near-complete areas than on the conventional areas. For fuels management and for wildlife, there is no appreciable difference between logging methods. Regeneration success and the soil-hydrology-nutrient regimen cannot be evaluated for several more years.

7. From a practical standpoint, the near future of 10 or 20 years hence should be considered the relevant time period for comparing nondollar benefits. After that, nondollar considerations on conventional and near-complete logging areas are expected to have similar value.

# LITERATURE CITED


Boster, Ronald, and T. C. Daniel
1972. Measuring public response to vegetative management. P. 38-43, 16th Annu. Ariz. Watershed Symp. Proc., Ariz. Water Comm., Rep. 2.

Brown, James K.
1974. Reduction of fire potential in lodgepole pine due to more complete utilization. USDA For. Serv. Res. Note INT-181, 6 p. illus.

Daniel, Terry C., Lawrence Wheeler, Ron S. Boster, and Paul R. Best, Jr.
1973. Quantitative evaluation of landscapes: an application of signal detection analysis to forest management alternatives. Man-Environ. Syst. 3(5)

Foulger, A. N., and Johnny Harris
1973. Volume of wood, bark, and needles after clearcutting a lodgepole pine stand. J. For., 71(2):93-95, illus.

Galbraith, Marlin C.
1972. Environmental effects of timber harvest and utilization of logging residues, p. 314-331. *In*: Environmental Affairs, Boston College Environmental Law Center 11(2)

Gardner, R. B., and W. S. Hartsog
1973. Logging equipment, methods, and cost for near-complete harvesting of lodgepole pine in Wyoming. USDA For. Serv. Res. Note INT-147, 15 p. illus.

Heebink, Bruce
1974. Particleboards from lodgepole pine forest residue. USDA For. Prod. Lab. Res. Pap. 221.

Lotan, James E., and Allen K. Dahlgreen
1971. Hand preparation of seedbeds improves spot seeding of lodgepole pine in Wyoming. USDA For. Serv. Res. Note INT-148, 7 p. illus.

Rickard, Wesley, Jay M. Hughes, and Carl A. Newport
1967. Economic evaluation and choice in old growth Douglas-fir landscape management. U.S. For. Serv. Res. Pap. PNW-49.

# APPENDIX

Table 4.--*Net dollar values per acre for various logging and postlogging treatments*

| Conditions | Net $/acre | | |
|---|---|---|---|
| | Conventional | Near-complete | |
| | | Chips=$0 | Chips=$7 |
| Actual; pile/burn and plant | 524 | -443 | -103 |
| Uniform volumes with 80 percent sawlog recovery; pile/burn and plant | 416 | -296 | -16 |
| Uniform volumes; 100% sawlog recovery; pile/burn and plant | 416 | -91 | 154 |
| Uniform volumes; 100 percent sawlog recovery; favorable logging; broadcast burn and plant | 451 | 143 | 388 |
| Uniform volumes; 100 percent sawlog recovery; favorable logging; broadcast burn and seed | 498 | 233 | 478 |

Table 5.--*Sawlog and chip volumes, near-complete and conventional units*

| Products | Near-complete | | | Conventional | | |
|---|---|---|---|---|---|---|
| | Unit 1 | Unit 4 | Ave. | Unit 2 | Unit 3 | Ave. |
| Sawlog: | | | | | | |
| Inventoried volume, Mbf/acre[1] | 20.5 | 18.7 | 19.6 | 24.9 | 22.0 | 23.4 |
| Harvested volume, Mbf/acre[2] | 14.7 | 15.2 | 15.0 | 25.1 | 21.4 | 23.2 |
| Assumed uniform volume, Mbf/acre | -- | -- | 20 | -- | -- | 20 |
| Residues: | | | | | | |
| Inventoried volume, BDU/acre[3] | 49.6 | 48.5 | 49.0 | -- | -- | -- |
| Harvested volume, BDU/acre[4] | 50.1 | 45.4 | 47.7 | -- | -- | -- |
| Assumed uniform volume BDU/acre | | | | | | |
| 80 percent sawlog recovery | -- | -- | 40 | -- | -- | -- |
| 100 percent sawlog recovery | -- | -- | 35 | -- | -- | -- |

[1]Converted from inventory cubic volumes reported in footnote 2 below.

[2]R. B. Gardner and David Hann. Utilization of lodgepole pine logging residues in Wyoming increases fiber yield. USDA For. Serv. Res. Note INT-160, 1972.

[3]Sum of nonsawlog trees, top portions of sawlog trees, and material on ground, converted from cubic volumes in footnote 2 above.

[4]R. B. Gardner and W. S. Hartsog. Logging equipment, methods, and cost for near-complete harvesting of lodgepole pine in Wyoming. USDA For. Serv. Res. Pap. INT-147, 1973.

Table 6.--*Logging costs, stump to truck*

| Products | Near-complete | Conventional |
|---|---|---|
| | *- - - Dollars per unit[1] - - -* | |
| Sawlogs, Mbf: | | |
| Actual | 23.07 | 22.83 |
| Simulated favorable logging | 17.70 | -- |
| Chips, bone dry unit: | | |
| Actual | 14.93 | -- |
| Simulated favorable logging | 11.33 | -- |

[1]Derived from Gardner and Hartsog, Logging equipment, methods, and cost for near-complete harvesting of lodgepole pine in Wyoming. USDA For. Serv. Res. Pap. INT-147, 1973.

Table 7.--*Wildlife evaluation for various species alternative harvest systems, lodgepole pine type, Teton National Forest*

(Index: 0 = least favorable for species; 100 = most favorable for species)

| | | Year 1 | | Year 20 | | Year 100 | |
|---|---|---|---|---|---|---|---|
| | | Forage | Cover | Forage | Cover | Forage | Cover |
| MOOSE | | | | | | | |
| Uncut Stand | | 90 | 100 | 80 | 100 | 70 | 100 |
| Near-complete | Natural regeneration | 10 | 0 | 50 | 50 | 90 | 100 |
| do. | Planted | 10 | 0 | 50 | 70 | 90 | 100 |
| Near-complete chip spread | Natural regeneration | 0 | 0 | 10 | 10 | 30 | 40 |
| do. | Planted | 0 | 0 | 10 | 70 | 30 | 100 |
| Pile/burn | Natural regeneration | 5 | 5 | 50 | 50 | 90 | 100 |
| do. | | 5 | 5 | 50 | 70 | 90 | 100 |
| B'dcast burn | Natural regeneration | 5 | 5 | 50 | 50 | 90 | 100 |
| do. | Planted | 5 | 5 | 50 | 70 | 90 | 100 |
| ELK | | | | | | | |
| Uncut Stand | | 70 | 100 | 60 | 100 | 50 | 100 |
| Near-complete | Natural regeneration | 10 | 0 | 100 | 50 | 90 | 100 |
| do. | Planted | 0 | 0 | 100 | 70 | 90 | 100 |
| Near-complete chip spread | Natural regeneration | 0 | 0 | 20 | 10 | 40 | 50 |
| do. | Planted | 0 | 0 | 20 | 70 | 40 | 100 |
| Pile/burn | Natural regeneration | 5 | 0 | 100 | 50 | 90 | 100 |
| do. | Planted | 5 | 0 | 100 | 70 | 90 | 100 |
| B'dcast burn | Natural regeneration | 5 | 0 | 100 | 50 | 90 | 100 |
| do. | Planted | 5 | 0 | 100 | 70 | 90 | 100 |
| BIRDS | | | | | | | |
| Near-complete | Natural regeneration | 10 | 0 | 50 | 70 | 90 | 100 |
| do. | Planted | 10 | 0 | 50 | 80 | 80 | 90 |
| Near-complete chip spread | Natural regeneration | 0 | 0 | 10 | 70 | 30 | 50 |
| do. | Planted | 0 | 0 | 10 | 80 | 30 | 90 |
| Pile/burn | Natural regeneration | 10 | 30 | 80 | 70 | 90 | 100 |
| do. | Planted | 10 | 30 | 80 | 80 | 90 | 90 |
| B'dcast burn | Natural regeneration | 10 | 30 | 80 | 70 | 90 | 100 |
| do. | Planted | 10 | 30 | 90 | 80 | 90 | 90 |
| POCKER GOPHERS | | | | | | | |
| Uncut Stand | | 30 | | 30 | | 40 | |
| Near-complete | Natural regeneration | 10 | | 100 | | 60 | |
| do. | Planted | 10 | | 80 | | 50 | |
| Near-complete chip spread | Natural regeneration | 0 | | 10 | | 20 | |
| do. | Planted | 0 | | 5 | | 10 | |
| Pile/burn | Natural regeneration | 10 | | 100 | | 60 | |
| do. | Planted | 10 | | 80 | | 50 | |
| B'dcast burn | Natural regeneration | 10 | | 100 | | 60 | |
| do. | Planted | 10 | | 80 | | 50 | |

Source: G. Gruell, Office Report, Teton National Forest, June 15, 1973

Table 8.--*Manager's esthetic evaluation for alternative harvest method first year after logging and projections for 10 and 20 years hence*

(Index number, 0 = low esthetic value, 100 = high esthetic value)

| Activity viewpoint | No harvest | Conventional: pile/burn | Near-complete | Chips spread |
|---|---|---|---|---|
| FIRST YEAR | | | | |
| Moving car | 100 | 20 | 73 | 67 |
| Hiking or horseback | 100 | 10 | 71 | 65 |
| Camping | 100 | 15 | 73 | 67 |
| Picture taking | 100 | 10 | 71 | 65 |
| From overlook | 100 | 5 | 68 | 62 |
| From aircraft | 100 | 20 | 73 | 67 |
| Recreation day use | 100 | 5 | 71 | 65 |
| YEAR 10 | | | | |
| Moving car | 94 | 30 | 88 | 69 |
| Hiking or horseback | 88 | 20 | 83 | 67 |
| Camping | 90 | 25 | 88 | 69 |
| Picture taking | 85 | 20 | 83 | 67 |
| From overlook | 80 | 15 | 78 | 64 |
| From aircraft | 95 | 30 | 88 | 69 |
| Recreation day use | 80 | 15 | 78 | 67 |
| YEAR 20 | | | | |
| Moving car | 77 | 45 | 100 | 71 |
| Hiking or horseback | 70 | 35 | 100 | 69 |
| Camping | 72 | 40 | 100 | 71 |
| Picture taking | 70 | 35 | 100 | 69 |
| From overlook | 68 | 30 | 100 | 66 |
| From aircraft | 77 | 45 | 100 | 71 |
| Recreation day use | 68 | 30 | 100 | 69 |

Source: Derived from office report, Wyoming Logging Residue Study--Esthetic and Recreation Evaluation, by Reed Stalder, USDA Forest Service, Regional Office, Ogden.



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BENSON, ROBERT E.
1974. Lodgepole pine logging residues: management alternatives. USDA For. Serv. Res. Pap. INT-160, 28 p., illus. (Intermountain Forest & Range Exp. Station, Ogden, Utah 84401.)

Dollar and nondollar values are compared for alternative residue utilization levels in mature lodgepole pine.

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OXFORD: 31; 33. KEYWORDS: timber operations, slash, logging residue, utility values, lodgepole pine.

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